Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Statistics

(Faculty of Science & Technology)

F.Y.B.Sc. Statistics

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the program: F.Y.B.Sc. Statistics/ Statistical Techniques

Preamble of the syllabus:

The word ***Statistics*** is used in different ways in different contexts. To a cricket fan, Statistics is the information about runs scored or wickets taken by a player. To the manager of a manufacturing unit, Statistics may be the information about the process control. To a medical researcher investigating the effects of a new drug, Statistics are evidence of research efforts. To a college student, Statistics are the grades or marks scored in a course. Thus, in all these illustrations Statistics word refers to quantitative data in the area under study. Statistics as a subject is an important branch of knowledge and is devoted to various techniques of collection, presentation, analysis and interpretation of data. It is a science of learning fromdata.

Statistics provides tools for making decisions when conditions of uncertainty prevail. Hence these tools and techniques are used in almost all fields. Statistics is indispensable for people working in fields like agriculture, business, management, economics, finance, insurance, education, biotechnology and medical science etc. Since last two decade, with the help of computers large amount of data can be handled and more sophisticated statistical techniques can be used in an effective manner. Knowledge of different aspects of Statistics has become crucial. There is a continuous demand for statisticians in every field – education, industry, software, insurance, clinical trials data and research. The syllabus of the three Year B. Sc. degree course in Statistics is framed in such a way that the students at the end of the course can apply judiciously the statistical tools to a variety of data sets to arrive at someconclusions.

Statistics can be divided into two broad categories, (1) exploratory statistics or descriptive statistics, which is concerned with summarizing data and describing these data, and (2) confirmatory statistics or inferential statistics, which is concerned with making decisions about the population based on thesample.

Up to higher secondary school, students are mostly exposed to descriptive statistics. These techniques are briefly reviewed but the emphasis in degree course is on inferential statistics. At the end of the degree course a student is expected to apply the statistical tools to real life data and analyzeit.

Introduction: Choice based credit (semester) system:
B. Sc. in Statistics program is of three years duration, with semester pattern for all the three years. A student of three-year B.Sc. degree program will not be allowed to offer Statistics and Statistical Techniques simultaneously in any of the three years of the course. Students offering **Statistics** at the First year of the three-year B.Sc. course may be allowed to offer **Statistical Techniques** as one of their subjects in the second year of the three-year B.Sc. in place of Statistics. Students offering Statistical Techniques at the first year of the three-year B.Sc. course may be allowed to offer Statistics as one of their subjects in the second year of the three-year B.Sc. course in place of Statistical Techniques provided they satisfy other requirements regarding subject combinations, ifany.

At **first year of under-graduation**, students will be given the basic information that includes – methods of data representation and summarization. Correlation and regression are the forecasting tools that are frequently used in statistical analysis. These topics are studied in one of the papers in each semester. Further they are introduced to probability and different discrete probability distributions along with applications in the other paper. Relevant experiments on these topics will be included in practicalcourse. Further the students are expected start using some statistical software and verify the computations during practicals. It is a skill oriented part of the course.

At **second year of under-graduation,** students are expected to study various probability distributions and its applications to real life situations. It is a foundation for further theory. An important branch of Statistics, viz. testing of hypotheses related to mean, variance, proportion, correlation etc. will be introduced. Some topics related to applications of Statistics will be also introduced. Further the students are expected start using some statistical software and verify the computations during practicals. It is a skill oriented part of the course.

At **third year of under-graduation**, six theory papers deal with theoretical as well as applied aspect of statistics. Some papers papers such as distribution theory and parametric inference are core and and mathematical in nature. Some papers such as sampling methods and Design of Experiments are core and applied but less mathematical. In Design of Experiments paper, various designs used in agriculture and industry are studied agriculture, clinical trials. Papers of applied nature, like medical statistics, actuarial statistics, time series, and optimization techniques (operations research), statistical quality control. There are some skill oriented courses C programming and R software. There are three practical courses based on core courses. In one of the practical courses, project component will be introduced to get hands on training or experiential learning.

Structure of the Course

Structure of the course for three years and the pattern of examination and question papers are as specified below

Structure of F. Y. B. Sc. Statistics/ Statistical Techniques

Semester	Paper code	Paper	Paper title	credits	Marks CIA	ESE	Total
1	ST 111	I	Descriptive Statistics I	2	15	35	50
	ST 112	II	Discrete Probability	2	15	35	50
	ST113	III	Statistics Practical PaperI	1.5	15	35	50
2	ST121	I	Descriptive Statistics II	2	15	35	50
	ST122	II	Discrete Probability Distributions	2	15	35	50
	ST123	III	Statistics Practical Paper II	1.5	15	35	50

Structure of S. Y. B. Sc. Statistics

Semester	Paper code	Paper	Paper title	credits	Marks CIA	ESE	Total
3	ST 231	I	Statistics theory paper 1	2	15	35	50
	ST 232	II	Statistics theory paper 2	2	15	35	50
	ST233	III	Statistics Practical Paper	2	15	35	50
4	ST241	I	Statistics theory paper 1	2	15	35	50
	ST242	II	Statistics theory paper 2	2	15	35	50
	ST243	III	Statistics Practical Paper	2	15	35	50

Structure of T. Y. B. Sc. Statistics

Semester	Paper code	Paper	Paper title	credits	Marks CIA	ESE	Total
5	ST 351	I	Statistics theory paper 1	2	15	35	50
	ST 352	II	Statistics theory paper 2	2	15	35	50
	ST 353	III	Statistics theory paper 3	2	15	35	50
	ST 354	IV	Statistics theory paper 4	2	15	35	50
	ST 355	V	Statistics theory paper 5	2	15	35	50
	ST 356	VI	Statistics theory paper 6	2	15	35	50
	ST 357	VII	Statistics Practical Paper 1	2	15	35	50
	ST 358	VIII	Statistics Practical Paper 2	2	15	35	50
	ST 358	IX	Statistics Practical Paper 3	2	15	35	50
	ST 359	X	Skill enhancement course 1	2	15	35	50
	ST 3510	XI	Skill enhancement course 2	2	15	35	50
6	ST 361	I	Statistics theory paper 1	2	15	35	50
	ST 362	II	Statistics theory paper 2	2	15	35	50
	ST 363	III	Statistics theory paper 3	2	15	35	50
	ST 364	IV	Statistics theory paper 4	2	15	35	50
	ST 365	V	Statistics theory paper 5	2	15	35	50
	ST 366	VI	Statistics theory paper 6	2	15	35	50
	ST 367	VII	Statistics Practical Paper 1	2	15	35	50
	ST 368	VIII	Statistics Practical Paper 2	2	15	35	50
	ST 369	IX	Statistics Practical Paper 3	2	15	35	50
	ST 3610	X	Skill enhancement course 1	2	15	35	50
	ST 3511	XI	Skill enhancement course 2	2	15	35	50

SEMESTER – I

PAPER – I

ST – 111: Descriptive Statistics I

Objectives: The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data. At the end of this course students are expected to be able,

(i) to compute various measures of central tendency, dispersion, skewness and kurtosis.
(ii) to analyze data pertaining to attributes and to interpret theresults.

Unit 1. Introduction to Statistics(2L)**2H**

1.1 Meaning of Statistics as aScience.
1.2 Importance ofStatistics.
1.3 Scope of Statistics: In the field of Industry, Biological sciences, Medical sciences, Economics, Social Sciences, Management sciences, Agriculture, Insurance, Information technology, Education andPsychology.
1.4 Statistical organizations in India and their functions: CSO, ISI, NSSO,IIPS (Devnar, Mumbai), Bureau of Economics andstatistics.
1.5 Statistical Heritage (Indian Perspective: i)Dr. V. S. Huzurbazar, Dr. P.C. Mahalnobis, Dr. P. V. Sukhatme, Dr. C. R. Rao).

Unit 2. PopulationandSample (4L)**3H**

2.1 Types ofcharacteristics:
Attributes: Nominal scale, ordinal scale,
Variables: Interval scale, ratio scale, discrete and continuous variables,
difference between linear scale and circular scale
2.2 Types ofdata:
(a) Primary data, Secondarydata
(b) Cross-sectional data, time series data, directionaldata.

2.3 Notion of a statistical population:

Finite population, infinite population, homogeneous population and heterogeneous population. Notion of a sample and a random sampleMethods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRSWOR) stratified random sampling, systematic sampling, cluster sampling and two-stage sampling.

Unit 3. SummaryStatistics: **(**14 L) **12H**

3.1 Review/Revision of Presentation of Data.
Interpretation of Data from table and graph.
datavalidation

3.2 Frequency Classification: Raw data and its classification, ungrouped frequency distribution,Sturges' rule, grouped frequency distribution, cumulative frequency distribution,inclusive and exclusive methods of classification, Open end classes, and relativefrequencydistribution.

3.3 Measures of CentralTendency:
Concept of central tendency of statistical data, Statistical averages, characteristics of a

good statistical average.
Arithmetic Mean (A.M.): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, trimmed arithmeticmean.
Mode and Median: Definition, formulae (for ungrouped and grouped data), merits and demerits. Empirical relation between mean, median and mode.
Partition Values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data), Box Plot.
Geometric Mean (G.M.): Definition, formula, merits and demerits.
Harmonic Mean (H.M.): Definition. Formula, merits and demerits.
Order relation between arithmetic mean, geometric mean, harmonic mean
Weighted Mean: weighted A.M., G.M. and H.M.
Situations where one kind of average is preferable to others.

3.4 Measures ofDispersion:
Concept of dispersion, characteristics of good measure of dispersion.
Range, Semi-interquartile range (Quartile deviation): Definition, merits and demerits, Mean deviation: Definition, merits and demerits, minimality property (without proof), Variance and standard deviation: Definition, merits and demerits, effect of change of origin and scale, combined variance for n groups (derivation for twogroups).
Mean squared deviation: Definition, minimality property of mean squared deviation (with proof), Measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation(C.V.)

2. **Moments, SkewnessandKurtosis:**(8 L)**7H**

4.1 Raw moments (m'_r) for ungrouped and groupeddata.

Central moments (m_r) for ungrouped and grouped data, Effect of change of origin and scale.Relations between central moments and raw moments, upto 4-th order (without proof).

4.2 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequencydistribution.
Bowley'scoefficientofskewness:Bowley'scoefficientofskewnessliesbetween −1 to 1 (with proof), interpretation using Box plot.
Karl Pearson's coefficient ofskewness.
Measures of skewness based on moments($\widehat{\beta_1}$,$\widehat{\gamma_1}$).

4.3 Concepts of kurtosis, leptokurtic, mesokurtiand platykurticfrequency distributions.
Measures of kurtosis based on moments ($\widehat{\beta_2}$,$\widehat{\gamma_2}$).

5 Theory of Attributes: (8 L) **6H**

5.1 Attributes: Concept of a Likert scale, classification, notion of manifold classification, dichotomy, class- frequency, order of a class, positive class-frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to three attributes), and dot operator to find the relation between frequencies, fundamental set of class frequencies.

5.2 Consistency of data up to 2attributes.

5.3 Concepts of independence and association of two attributes.
Yule's coefficient of association (Q), $-1 \leq Q \leq 1$,interpretation.

Recommended Books:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, NewDelhi.
2. Ghosh, J. K. and Mitra, S. K., Parthsarthi, K. R. (1993). Glimpses of India's Statistics Heritage, Wiley publishing Co.
3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition,The World Press Pvt. Ltd.,Calcutta.
4. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, NewDelhi.
5. Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, Third Edition, Sultan Chand and Sons Publishers, NewDelhi.
6. Neil A. Weiss, (2016). Introductory Statistics, Tenth Edition, Pearson.
7. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, NewDelhi.
8. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentce Hall of India, NewDelhi.
9. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East-WestPress.

SEMESTER – I

PAPER – II

ST – 112: Discrete Probability and Probability DistributionsI

Objectives

The main objective of this course is to introduce to the students the basic concepts of probability, axiomatic theory of probability, concept of random variable, probability distribution (univariate and bivariate) discrete random variables, expectation and moments of probability distribution. By the end of the course students are expected to be able

(i) to distinguish between random and non-randomexperiments.
(ii) to find the probabilities ofevents.
(iii) to obtain a probability distribution of random variable (one or two dimensional) in the given situation.

1. Basics of Probability:(6L)**4H**

1.1 Experiments/Models, Ideas of deterministic and non-deterministic models. Random Experiment, concept of statisticalregularity.

1.2 Definitions of - (i) Sample space, (ii) Discrete sample space: finite and countably infinite, (iii) Event, (iv) Elementary event, (v) Complement of an event. (vi) Certain event (vii) Impossibleevent

Concept of occurrence of anevent.

Algebra of events and its representation in set theory notation. Occurrence of followingevents.

(i) at least one of the givenevents,
(ii) none of the givenevents,
(iii) all of the givenevents,
(iv) mutually exclusiveevents,
(v) mutually exhaustiveevents,
(vi) exactly one event out of the givenevents.

1.3 Classical definition of probability and itslimitations.

Probability model, probability of an event, equiprobable and non-equiprobable sample space,

1.4 Axiomatic definition ofprobability. Theorems and results on probability with proofs based on axiomatic definition such as $P(AUB)=P(A)+P(B)-P(A \cap B)$. Generalization $P(AUBUC)$,$0 \leq P(A) \leq 1$, $P(A) + P(A') = 1$, $P(\Phi) = 0$,$P(A) \leq P(B)$ when $A \subset B$

Boole's inequality.

2. Conditional Probability and Bayes'Theorem:(5L)**4H**

2.1 Definition of conditional probability of an event. Results on conditional probability.

Definition of independence of two events $P(A \cap B) = P(A) \cdot P(B)$

Pairwise independence and mutual independence for three events

Multiplication theorem

$P(A \cap B) = P(A) \cdot P(B|A)$. Generalization to

$P(A \cap B \cap C)$.

2.2 Partition of the samplespace, prior and posterior probabilities.Proof of Bayes' theorem. Applications of Bayes' theorem in reallife. True positive , false positive and sensitivity of test as application of Bayes' theorem.

3. Univariate Probability Distributions (Defined on Discrete Sample Space): (3L) 2**H**

Concept and definition of a discrete randomvariable.
Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.), F(·) of discrete random variable, properties ofc.d.f..
Mode and median of a univariate discrete probabilitydistribution.

4. Mathematical Expectation (Univariate Random Variable):(8L)**7H**

4.1 Definition of expectation (Mean) of a random variable, expectation of a function of a random variable, m.g.f. and c.g.f. Properties of m.g.fandc.g.f.
4.2 Definitions of variance, standard deviation (s.d.) and Coefficient of variation (c.v.) of univariate probability distribution, effect of change of origin and scale on mean, variance ands.d.
4.3 Definition of raw, central and factorial raw moments of univariate probability Distributions and their interrelations **(**withoutproof).
4.4 Coefficients of skewness and kurtosis based onmoments.

5 Some Standard Discrete Probability Distributions: (15L) 13H

5.1 Degenerate distribution (one point distribution):
P(X=c) =1, mean and variance.

5. 2 Uniform discrete distribution on integers 1 to n:
p.m.f., c.d.f., mean, variance, real life situations, comments on mode and median.
5.3 Bernoulli Distribution:p.m.f., mean, variance.

5.4 Binomial Distribution : p.m.f.

$$P(x) = \binom{n}{x} p^x q^{n-x}, x = 0,1,2,\dots,n; 0 < p < 1, q = 1-p$$
$$= 0, \text{ otherwise}$$

Notation: X ~ B(n, p).
Recurrence relation for successive probabilities, computation of probabilities of different events, mode of the distribution, mean, variance, m.g.f. and c.g.f. moments, skewness (comments when p = 0.5, p > 0.5, p < 0.5). Situations where this distribution is applicable.
Additive property for binomial distribution.
Conditional distribution of X given (X+Y) for binomial distribution.

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5.5 Hypergeometric Distribution: Necessity and importance of Hypergeometric distribution, capture-recapture method.
p.m.f. of the distribution,

$$p(x) = \frac{\binom{M}{x}\binom{N-M}{n-x}}{\binom{N}{n}}, \qquad x = 0,1,\dots,\min(M,n)$$
$$= 0, \quad \text{otherwise}$$

Notation : X ~ H(N,M,n).
Computation of probability, situations where this distribution is applicable, binomial approximation to hypergeometric probabilities, statement of mean and variance of the distribution (Derivation is not expected).

Recommended Books:

1. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, NewDelhi.
2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, NewDelhi.
3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
4. Hogg,R.V.andCraigR.G.(1989).IntroductiontoMathematicalStatistics,Ed. MacMillan Publishing Co., NewYork.
5. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co.,London.
6. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill BookCompany.
7. Rao, VLS Prakash (2008). First Course in Probability and Statistics, New Age International Publishers, NewDelhi.
8. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing,Inc.

SEMESTER I

Statistics Practical Paper III

ST – 113 : PRACTICALS

Pre-requisites: Knowledge of the topics in theory papers I and II.
Objectives: At the end of this course students are expected to be able

(i) to use various graphical and diagrammatic techniques and interpretation.
(ii) to analyse data pertaining to discrete and continuous variables and to interpret the results,
(iii) to compute various measures of central tendency, dispersion, skewness and kurtosis.
(iv) to interpret summary statistics of computer output.
(v) to summarize and analyze the data using computer.

S. No.	Title of the experiment	No. of Practicals
1	Diagrammatic representation of statistical data: simple and subdivided bar diagrams, multiple bar diagram, percentage bar diagram, pie diagram. Also using Ms-Excel/Any statistical software	2
2	Graphical representation of statistical data: Histogram, frequency curve and ogive curves. Determination of mode and median graphically. Also using Ms-Excel/Any statistical software	2
3	Tabulation	1
4	Data Interpretation form various graphs and diagrammes.	1
5	Use of random number tables to draw SRSWOR, SRSWR, stratified sample and systematic sample. Also using Ms-Excel/ Any statistical software	2
6	Computation of measures of central tendency and dispersion (ungrouped data). Use of an appropriate measure and interpretation of results and computation of partition values.	1
7	Computation of measures of central tendency and dispersion (grouped data). Use of an appropriate measure and interpretation of results and computation of partition values.	1
8	Measures of skewness and kurtosis, Box plot.	1
9	Computation of summary statistics using Ms-Excel/ Any statistical software	1
10	Project	3

SEMESTER – II

PAPER – I

Objectives: The main objective of this course is to acquaint students with bivariate data. They will be introduced to some methods of analysis of bivariate data. At the end of this course students are expected to be able,

(i) to compute the correlation coefficient for bivariate data and interpret it.
(ii) to fit linear, quadratic and exponential curves to the bivariate data to investigate relation between two variables.
(iii) to compute and interpret various index numbers.

ST - 121: Descriptive Statistics II

1 Correlation: (10L) **9H**

1.1 Bivariate data, Scatter diagram and interpretation.
Concept of correlation between two variables, positive correlation, negative correlation, no correlation.
Covariance between two variables (m_{11}): Definition, computation, effect of change of origin and scale.
1.2 Karl Pearson's coefficient of correlation (r): Definition, computation for ungrouped data and interpretation. Properties: (i) $-1 \leq r \leq 1$(with proof), (ii) Effect of change of origin and scale (with proof).
1.3 Spearman's rank correlation coefficient: Definition, derivation of formula, computation and interpretation (without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Spearman's rank correlation coefficient formula with correction for ties not expected.)

2**Fitting of Line (Regression Line):** (8L) **6H**

2.1 Concept of dependent and independent variables.
2.2 Identification of response and predictor variables and relation between them.
2.3 Meaning of regression, difference between correlation andregression, Connection between correlation and regression. Fitting of line Y= a + bX. a and b are estimated using least square method.Regression coefficient. Explained and unexplained variation, coefficient of determination, standard error of an estimate of line of regression. Interchanging the role of X and Y we can study some more properties.

3. **Curve Fitting:** (10L) **9H**

3.1 Necessity and importance of drawing second degree curve.
3.2 Fitting of second degree curve ($Y = a + b X + cX^2$),
3.3 Fitting of exponential curves of the type $Y = a\, b^X$ and $Y = aX^b$.
In all these curves constants a, b, c are found out by the method of least squares.
(Justification via determinant of matrix of second derivative/second derivative test).

4. **Index Numbers:**(8L) **6H**

4.1 Introduction and scope of Index Numbers. Various types of Index Numbers like Human Development Index, Happiness Index BSE sensitivity Index.
4.2 Definition and Meaning.

4.3 Problems/considerations in the construction of index numbers.
4.4 Simple and weighted price index numbers based on price relatives.
4.5 Simple and weighted price index numbers based on aggregates.
4.6 Laspeyre's, Paasche's and Fisher's Index numbers.
4.7 Consumer price index number: Considerations in its construction. Methods of construction of consumer price index number - (i) family budgetmethod
(ii) aggregate expenditure method
4.8 Shifting of base, splicing, deflating, purchasingpower.

Recommended Books:

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
2. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition,The World Press Pvt. Ltd.,Calcutta.
3. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, NewDelhi.
4. Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, Third Edition, Sultan Chand and Sons Publishers, NewDelhi.
5. Montgomery, D. C; Peck, E. A.; Vining, G. G.(2006). Introduction to Linear Regression Analysis, John Wiley and Sons
6. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, New Delhi.
7. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentce Hall of India, New Delhi.
8. Snedecor G. W. and Cochran W. G.(1989). Statistical Methods, Eighth Ed. East- West Press.

SEMESTER – II

PAPER – II

ST – 112: Discrete Probability and Probability Distributions II

Objectives: The main objective of this course is to introduce to the students some discrete Distributions and its application in real life.

(i) to apply standard discrete probability distribution to differentsituations.

(ii)tostudy properties of these distributions as well as interrelation between them.

1. Some Standard Discrete Probability Distributions: **(1 6 L) 1 3 H**

1.1Poisson distribution:

p.m.f. of the distribution

$$p(x) = \frac{e^{-m}m^{x}}{x!}, \quad x = 0,1,2,\ldots, \quad m > 0$$

= 0, otherwise

Notation: X ~P(m).
m.g.f. and c.g.f. Moments, mean,————variance, skewness and kurtosis.
Situations where this distribution is applicable.
Additive property for Poissondistribution.
Conditional distribution of X given (X+Y) for Poissondistribution.

1.2Geometric distribution:

Notation: X ~G(p),
Geometric distribution on support (0, 1, 2, ...,) with p.m.f. $p(x) = pq^{x}$.
Geometric distribution on support (1, 2, ...) with p.m.f. $p(x) = pq^{x-1}$. $0 < p < 1$, $q = 1 - p$.
Mean, variance, m.g.f. and c.g.f.
Situations where this distribution is applicable.
Lack of memory property.

2. Bivariate DiscreteProbabilityDistribution: (6L) 5H

2.1 Definition of two-dimensional discrete random variable, its joint p.m.f. and its distribution function and their properties.

2.2 Concept of identically distributedr.vs.

2.3 Computation of probabilities of events in bivariate probabilitydistribution.

2.4 Concepts of marginal and conditional probabilitydistributions.

2.5 Independence of two discrete random variables based on joint and marginal p.m.f.s

3 Mathematical Expectation (BivariateRandomVariable) (14L) 12H

3.2 Definition of raw and central moments, m.g.f,c.g.f.

3.3 Theorems on expectations of sum and product of two jointly distributed random variables.

3.4 Conditionalexpectation.

3.5 Definitions of conditional mean and conditionalvariance.

3.6 Definition of covariance, coefficient of correlation, independence anduncorrelatedness of twovariables.

3.7 Variance of linear combination of variables Var(aX +bY).

Recommended Books:

1. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, NewDelhi.
2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals ofMathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, NewDelhi.
3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
4. Hogg,R.V.andCraigR.G.(1989).IntroductiontoMathematicalStatistics,Ed. MacMillan Publishing Co., NewYork.
5. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co.,London.
6. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill BookCompany.
7. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing,Inc.

Reference Websites for Paper I and Paper II:

1. www.stats.unipune.ac.in (100 Data sets for Statistics Educationby Dr. Anil P. Gore, Dr. Mrs. S. A. Paranjpe and Madhav B. Kulkarni available in ISPSfolder).
2. www.freestatistics.tk(National StatisticalAgencies)
3. www.psychstat.smsu.edu/sbk00.htm(Onlinebook)
4. www.bmj.bmjournals.com/collections/statsbk/index.shtml
5. www.statweb.calpoly.edu/bchance/stat-stuff.html
6. www.amstat.org/publications/jse/jse-data-archive.html(International journal on teaching and learning ofstatistics)
7. www.amstat.org/publications/chance(Chancemagazine)
8. www.statsci.org/datasets.html(Datasets)
9. www.math.uah.edu/stat(Virtual laboratories inStatistics)
10. www.amstat.org/publications/stats(STATS : the magazine for students of Statistics)
11. www.stat.ucla.edu/cases(Case studies inStatistics).
12. www.statsoft.com
13. www.statistics.com
14. www.indiastat.com
15. www.unstat.un.org
16. www.stat.stanford.edu
17. www.statpages.net
18. www.wto.org
19. www.censusindia.gov.in
20. www.mospi.nic.in
21. www.statisticsofindia.in

SEMESTER II

Paper III

ST – 123 : PRACTICALS

Pre-requisites: Knowledge of the topics in theory papers I and II.
Objectives: At the end of this course students are expected to be able

(i) to compute correlation coefficient, regressioncoefficients,
(ii) to compute probabilities of bivariatedistributions,
(iii) to fit binomial and Poissondistributions
(iv) to compute probabilities of bivariatedistributions.
(v) to draw random samples from Poisson and binomial distributions.

S. No.	Title of the experiment	No. of Practicals
1	Scatter diagram, correlation coefficient (ungrouped data). Fitting of line of regression.	2
2	Fitting of second degree curve, exponential curve of type $Y = ab^x$, $Y = ax^b$	2
3	Fitting of Binomial distribution and computation of expected frequencies.	1
4	Fitting of Poisson distribution and computation of expected frequencies.	1
5	Applications of Binomial &hypergeometric distributions.	1
6	Applications of Poisson & geometric distributions.	1
7	Model sampling from Poisson and Binomial distributions.	1
8	Index numbers.	1
9	Scatter diagram, correlation coefficient, fitting of a line of regression, fitting of second degree curve **using**Ms-excel/ Any statistical software& interpretation.	2
10	Project	3

Notes:

1. For project, a group of maximum 8 students bemade.
2. All the students in a group be given equal marks forproject.
3. Different data sets from newspapers, internet, magazines may be collected and students will be asked to use Statistical techniques/tools which they havelearnt.
4. Students must complete all the practicals to the satisfaction of the teacher concerned.
5. Students must produce at the time of practical examination, the laboratory journal along with the completion certificate signed by the Head of the Department.